

CLAIMS

1. A process for fabricating a layered material composition, comprising steps for:
  - a) forming, upon an upper surface of a substructure, a structured layer having a top surface and a substantially planar bottom surface;
  - b) planarizing the top surface of said structured layer by chemical-mechanical polishing; and,
  - c) repeating steps a and b to form the layered material composition, wherein the planarized top surface of a given layer forms the upper surface of the substructure upon which the next structured layer is to be grown..
2. The process of Claim 1, wherein all structured layers have the same structure and composition.
3. The process of Claim 1, wherein at least two of the structured layers differ in structure.
4. The process of Claim 1, wherein at least two of the structured layers differ in composition.
5. The process of Claim 1, wherein the material of at least one structured layer has spatially varying physical properties.
6. The process of Claim 5, wherein said spatially varying physical properties vary substantially periodically in the plane of the bottom surface of said structured layer.
7. The process of Claim 5, wherein said spatially varying physical properties vary substantially quasiperiodically in the plane of the bottom surface of said structured layer.
8. The process of Claim 5, wherein said spatially varying physical properties are substantially invariant in the plane of the bottom surface of said structured layer.
9. The process of Claim 5, wherein the layered material composition is a photonic lattice, and said spatially varying physical properties comprise refractive index.
10. The process of Claim 5, wherein the top surface and the bottom surface of the structured layer are substantially parallel.

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11. The process of Claim 10, wherein the upper surface of the substructure is planarized using chemical-mechanical polishing prior to forming said structured layer.
12. The process of Claim 10, wherein said structured layer comprises a configuration of tiles, where each tile is substantially identical to some reference tile chosen from a group of reference tiles.
13. The process of Claim 12, wherein said configuration comprises a periodic pattern of said tiles.
14. The process of Claim 12, wherein said configuration comprises a periodic tiling consisting essentially of said tiles.
15. The process of Claim 12, wherein said configuration comprises a quasiperiodic tiling consisting essentially of said tiles.
16. The process of Claim 12, wherein said structured layer consists essentially of said tiles.
17. The process of Claim 12, wherein the step of forming said structured layer comprises the steps of:
  - a) depositing a first film of a first material upon said upper surface;
  - b) defining a pattern upon said first film;
  - c) patterning said first film according to said pattern; and,
  - d) depositing, atop said patterned first film, a second film of a second material.
18. The process of Claim 17, wherein the patterning step comprises removing material from said first film to a depth equal to the thickness of said first film.
19. The process of Claim 17, wherein the thickness of said first film plus the thickness of said second film, less the depth of material removed from said first film in the patterning step, is at least equal to the desired thickness of said structured layer.
20. The process of Claim 17, further comprising the step of removing said first material from said structured layer.
21. The process of Claim 17, further comprising the step of removing said second material from said structured layer.

22. The process of Claim 17, further comprising the separate steps of removing said first material from said structured layer, and of removing said second material from said structured layer.
23. The process of Claim 17, wherein the step of patterning comprises use of an anisotropic etching technique.
24. The process of Claim 17, wherein the step of patterning comprises use of an isotropic etching technique.
25. The process of Claim 17, wherein the step of patterning comprises use of an etching technique which preferentially etches said first film relative to the upper surface and proximate regions of said substructure.
26. The process of Claim 17, wherein said pattern is substantially one dimensional.
27. The process of Claim 26, such that said patterned first film has a shape which is substantially invariant along directions parallel to a first axis which lies in the plane of the top surface of said first film.
28. The process of Claim 17, wherein said pattern is substantially two dimensional.
29. The process of Claim 28, such that said patterned first film has a shape which is substantially periodic in the plane of the top surface of said first film.
30. The process of Claim 17, wherein said pattern is substantially quasiperiodic.
31. The process of Claim 5, wherein the step of forming said structured layer comprises a fillet procedure comprising the following steps:
- a) patterning a fillet definition structure comprising fillet defining features; and,
  - b) overcoating said fillet definition structure with a protofillet layer.
32. The process of Claim 31, wherein said fillet procedure further comprises filling in the spaces between the overcoated fillet defining features with a filler material.
33. The process of Claim 31, wherein said fillet procedure further comprises reducing the thickness of the overcoated fillet definition structure.
34. The process of Claim 31, wherein the step of reducing the thickness of the overcoated fillet definition structure comprises the use of an anisotropic etching technique.

35. The process of Claim 31, wherein the step of reducing the thickness of the overcoated fillet definition structure comprises the use of chemical-mechanical polishing.
36. The process of Claim 31, wherein the step of reducing the thickness of the overcoated fillet definition structure also exposes all parts of the fillet definition structure to etching processes.
37. The process of Claim 31, wherein said fillet procedure further comprises the step of removing part or all of the fillet definition structure.
38. The process of Claim 37, such that isolated fillet structures are generated.
39. The process of Claim 38, wherein said fillet procedure further comprises extending said isolated fillet structures into underlying layers via etching wherein the isolated fillet structures function as a fillet etching mask.
40. The process of Claim 38, wherein said fillet procedure further comprises the steps of:
- a) filling in the spaces between said isolated fillet structures to a depth at least equal to that of the design height of said isolated fillet structures; and,
  - b) planarizing the top surface using chemical-mechanical polishing.
41. The process of Claim 1, further comprising aligning the structured layer with respect to the substructure so that the resulting structure is consistent with the design of the layered material composition.
42. The process of Claim 41, wherein said substructure comprises alignment marks and the process of aligning the structured layer and the substructure uses said alignment marks as reference points.
43. The process of Claim 42, where said alignment marks are traceable to an original set of alignment marks on the layered material composition.
44. A layered material composition made using the method of Claim 1.
45. A layered material composition made using the method of Claim 17.
46. A layered material composition made using the method of Claim 31.
47. A layered material composition made using the method of Claim 40.
48. An apparatus comprising a layered material composition made using the method of Claim 1.

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